



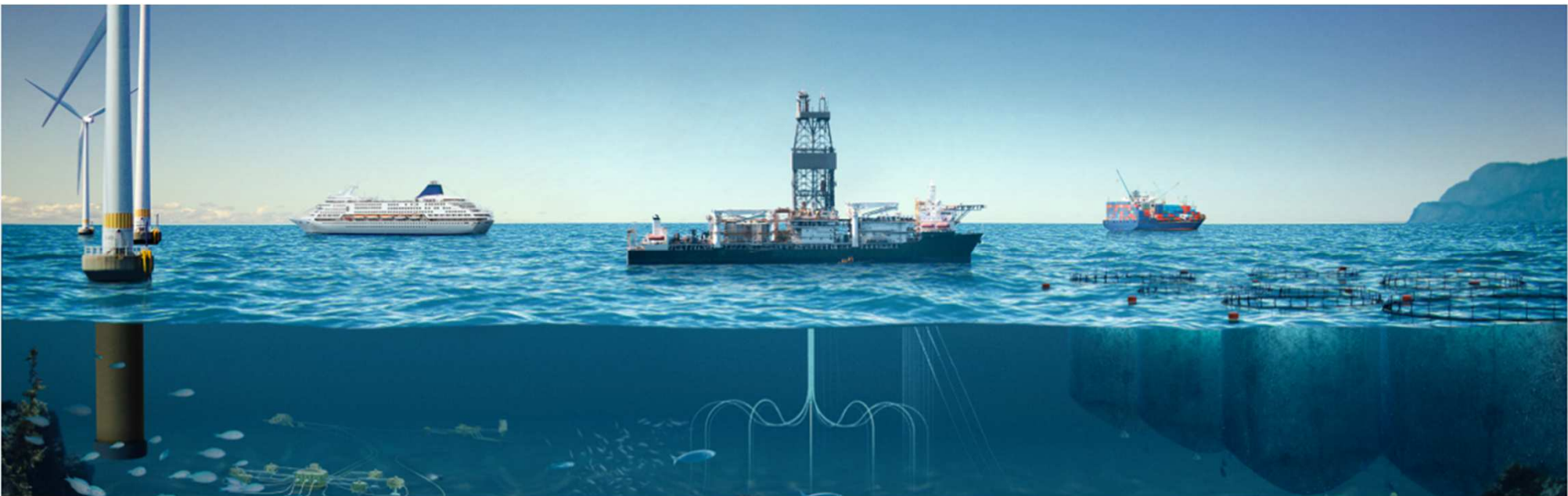
WHEN TRUST MATTERS

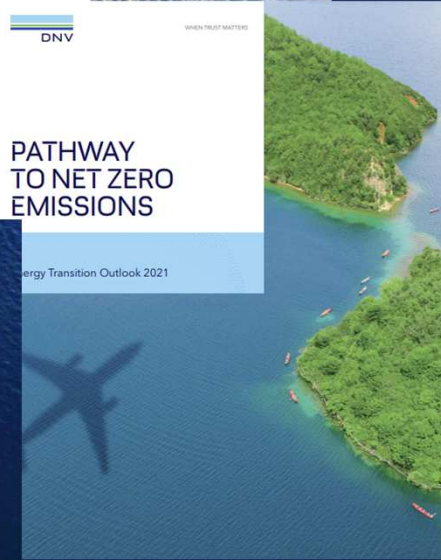
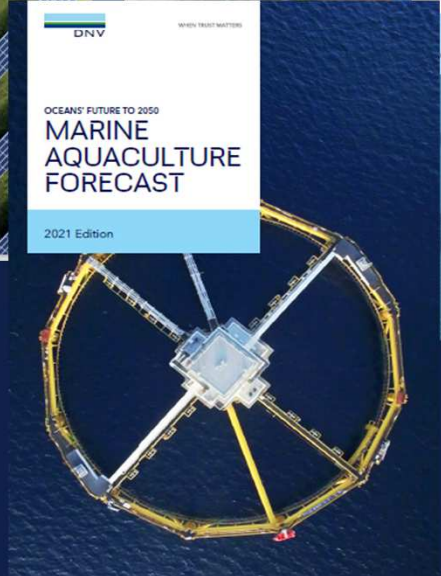
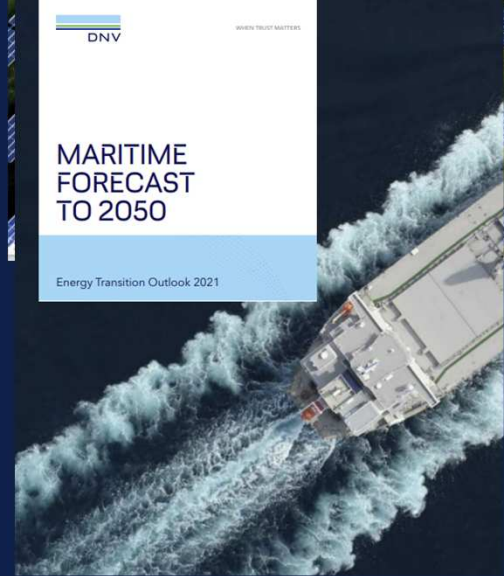
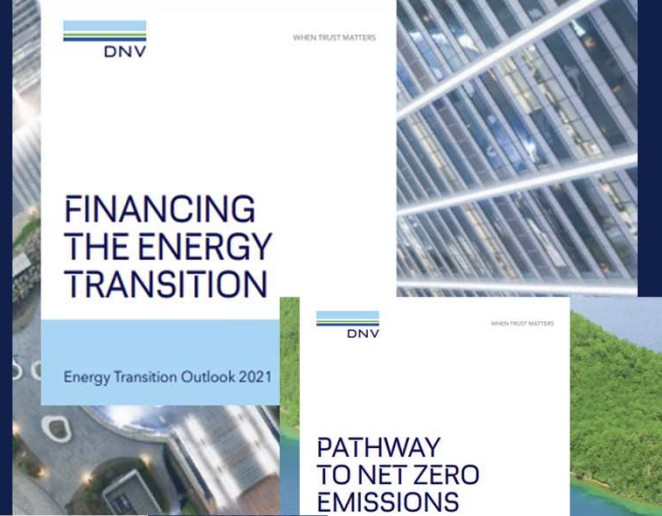
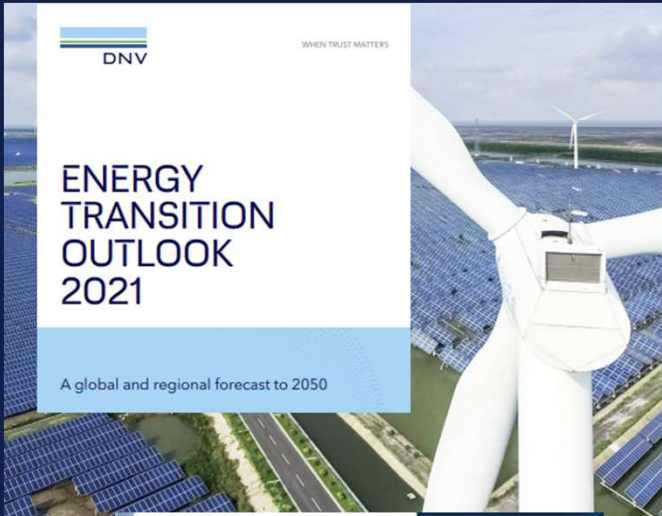
Ocean Space Update & Market Outlook

ROC Houston

Erik A.M.Henriksen

05 May 2022

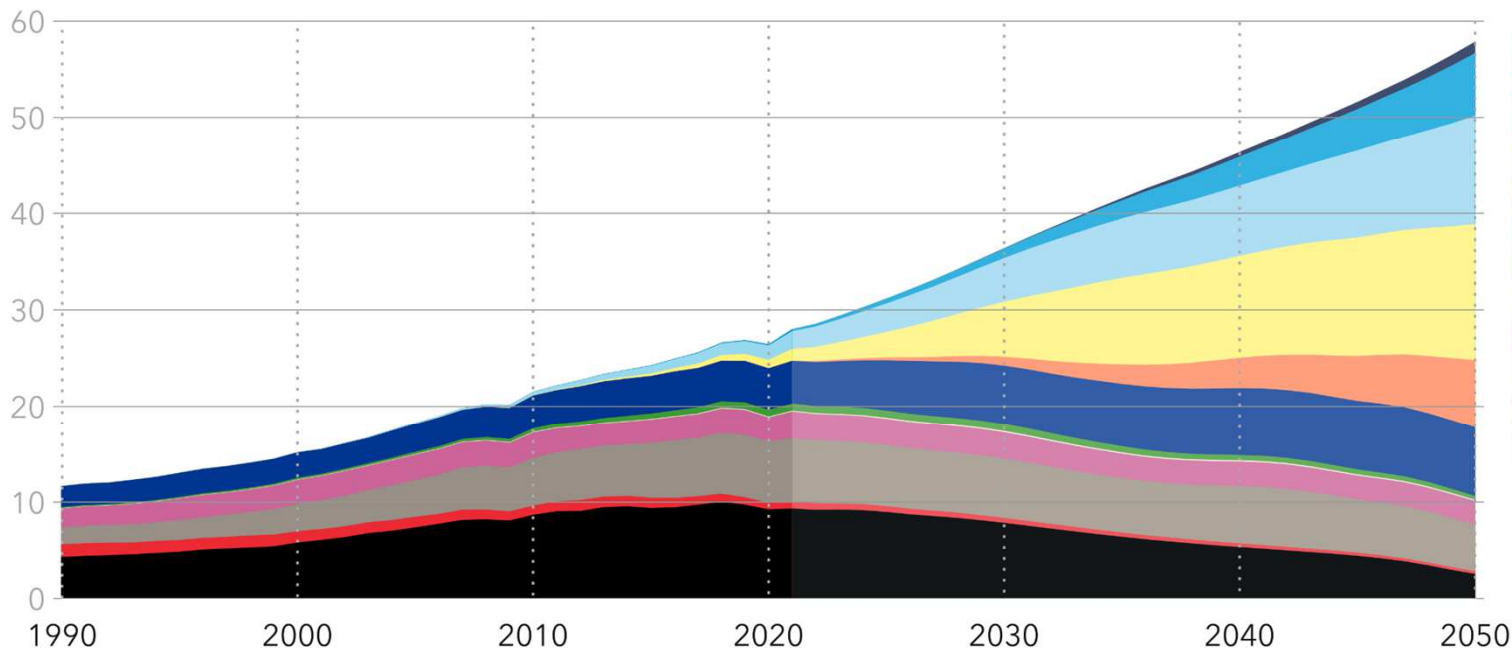




A huge shift in the energy system towards 2050

World grid-connected electricity generation by power station type

Units: PWh/yr



Historical data source: IEA WEB (2020), GlobalData (2021)

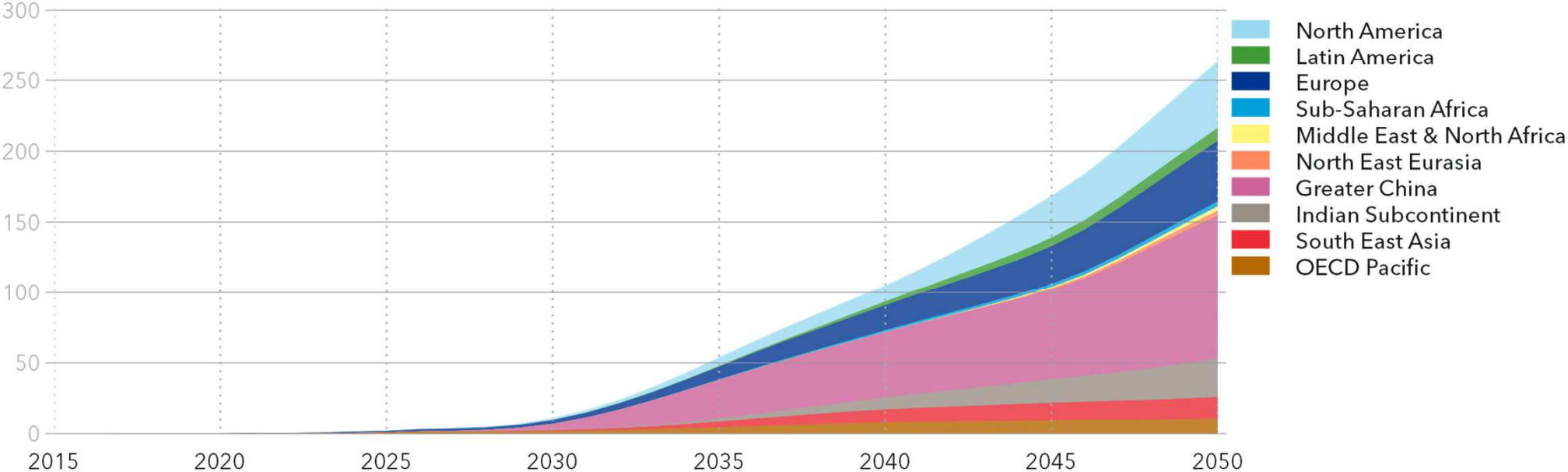
- Floating offshore wind
- Fixed offshore wind
- Onshore wind
- Solar PV
- Solar plus storage
- Hydropower
- Bioenergy
- Geothermal
- Nuclear
- Gas-fired
- Oil-fired
- Coal-fired

**Wind + Solar = 69%
share of electricity
generation in 2050**

Europe to lead the developments in most of the 2020s, but will be passed by Asia in 2030s and North America in 2040s

Installed floating offshore wind capacity by region

Units: GW



©DNV Energy Transition Outlook 2021

Historical data source: GlobalData (2021), IRENA (2021)

Offshore renewables entering exponential growth

Exponential growth

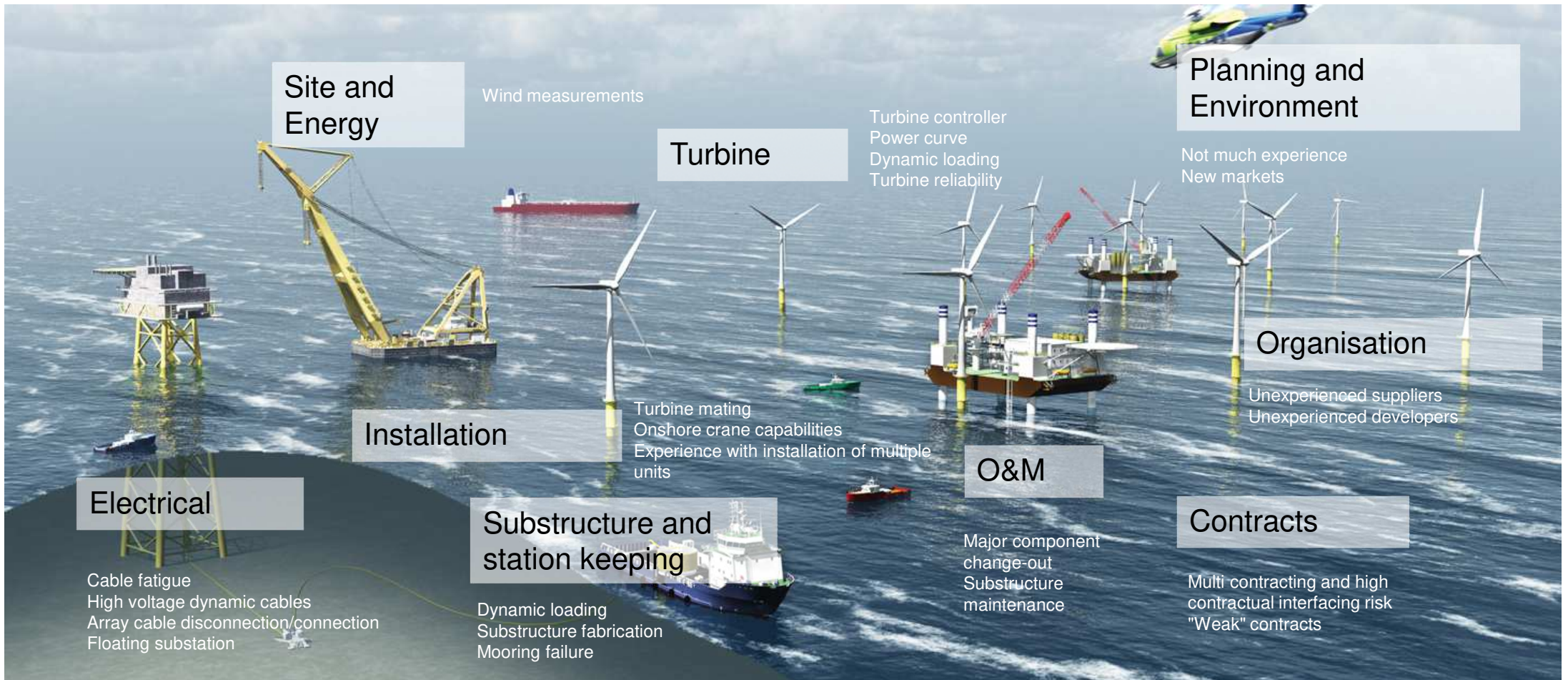
- Today: ~160 offshore wind farms, ~7200 turbines, 31 GW
- 2025 projection: ~350 offshore wind farms, ~15000 turbines 90 GW
- Project sanctioning in 2021 : 86 offshore wind farms, 27GW
- Capacity growth of ~7x by 2030

Key enablers

- Larger turbines (15+ MW)
- Mega-sized projects (hundreds of turbines)
- Co-locating 3 GW or more projects
- More dedicated offshore supply chain
- High capacity installation and maintenance vessels

Offshore wind will generate almost 10% of electricity globally by 2050

Offshore wind – Challenges & Opportunities



Site and Energy

Wind measurements

Turbine

Turbine controller
Power curve
Dynamic loading
Turbine reliability

Planning and Environment

Not much experience
New markets

Organisation

Unexperienced suppliers
Unexperienced developers

Installation

Turbine mating
Onshore crane capabilities
Experience with installation of multiple units

O&M

Major component change-out
Substructure maintenance

Contracts

Multi contracting and high contractual interfacing risk
"Weak" contracts

Electrical

Cable fatigue
High voltage dynamic cables
Array cable disconnection/connection
Floating substation

Substructure and station keeping

Dynamic loading
Substructure fabrication
Mooring failure

Wind Turbine Installation Vessels

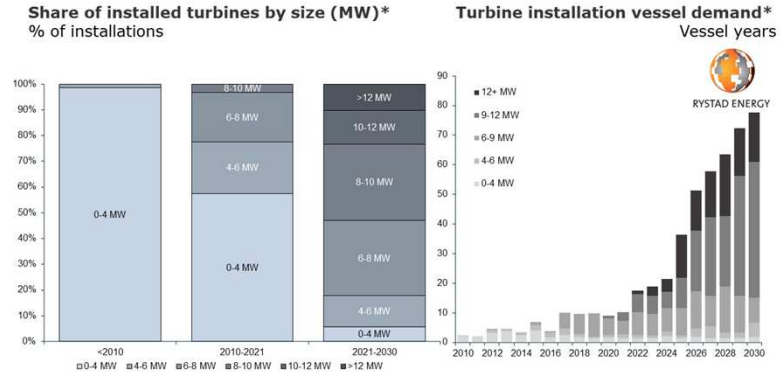


Offshore wind turbines are growing in size as technology advances and demand for renewable energy soars but installing them could be a headache for operators as demand will outpace the supply of capable vessels by 2024, Rystad Energy research shows. Operators will have to invest in new vessels or upgrade existing ones to install the super-sized turbines that are expected to become the norm by the end of the decade, or the pace of offshore wind installations could slow down.

Wind turbines globally, excluding China, have experienced a growth spurt in recent years, rising from an average of 3 megawatts (MW) in 2010 to 6.5 MW today, with the largest in operation clocking in at 10 MW. Turbines larger than 8 MW accounted for just 3% of global installations between 2010 and 2021, but that percentage is forecast to surge to 53% by 2030.

As the energy transition accelerates, demand for offshore wind turbine installation vessels worldwide, excluding China, will rocket from 11 vessel years in 2021 to almost 79 vessel years by 2030. The need for installation vessels for turbines larger than 9 MW, which was nonexistent in 2019, will grow significantly by the end of the decade and reach 62 vessel years in 2030.

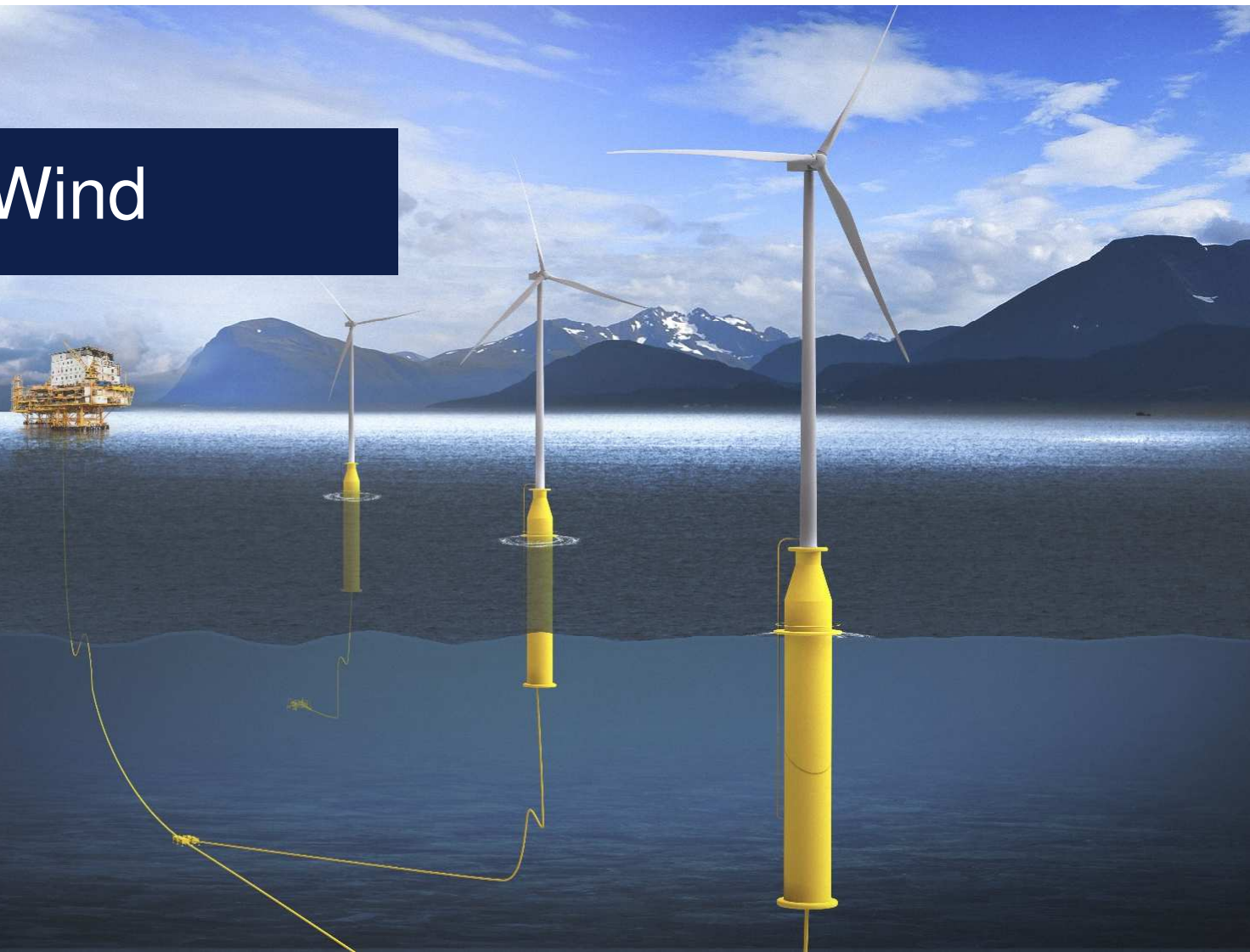
"When turbines were smaller, installation could be handled by the first-generation fleet of offshore wind vessels or converted jackups from the oil and gas industry. However, as operators continue to favor larger turbines, a new generation of purpose-built vessels is required to meet demand," says Martin Lysne, Rystad Energy rigs and vessels analyst.



*Global data, excluding China.
Source: Rystad Energy OffshoreWindCube, Rystad Energy research and analysis

Rystad Energy released a report in February stating that the need for additional WTIVs is grossly underestimated with 60 additional units required by 2030 to balance demand

Floating Offshore Wind

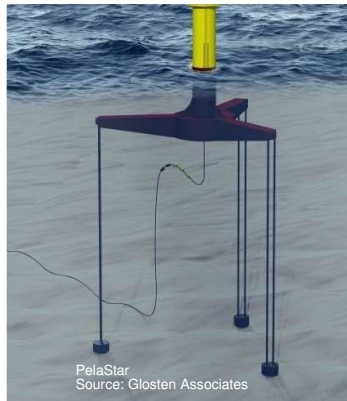


Floating Offshore Wind

Environmental Conditions



Wind farm influence



Floater



Wind Turbine



96 farms, 14.5 GW, 1300 turbines could be active by 2030

Market Updates: Floating Offshore Wind Profile

Clarksons Research has released onto its *Renewables Intelligence Network (RIN)* platform a new briefing profiling the floating offshore wind sector, examining capacity trends, the maritime supply chain and key projects in the industry. Reviewing the data, Steve Gordon, Managing Director of Clarksons Research commented:

- While "floating wind" is only a small part of the offshore wind industry today (only 10 projects of 124 MW are active, with a further 8 projects of 165 MW under construction), strong growth is expected from the middle of the 2020s as the sector reaches commercialisation (our projections suggest that **96 farms, 14.5 GW, 1,300 turbines could be active by 2030**)

Technip Floater Concept Wins DNV Approval

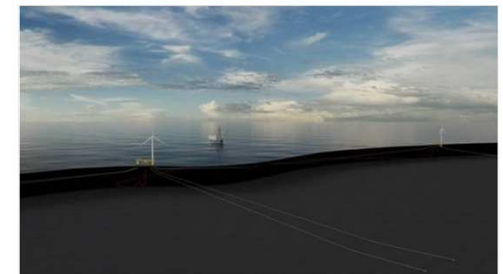
© 10 Dec 2021 by renews.biz

Technip Energies' floating offshore wind concept has been awarded approval in principle by DNV.



DNV Grants AiP for Odfjell Oceanwind's Floating Wind Foundation Designed for up to 15MW Turbines

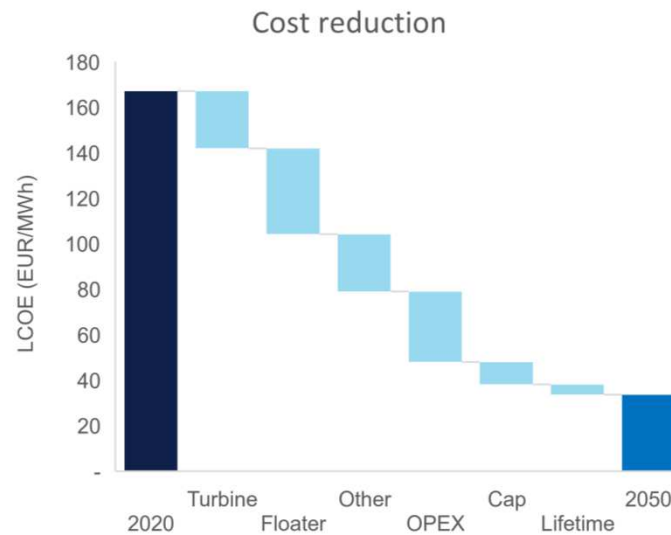
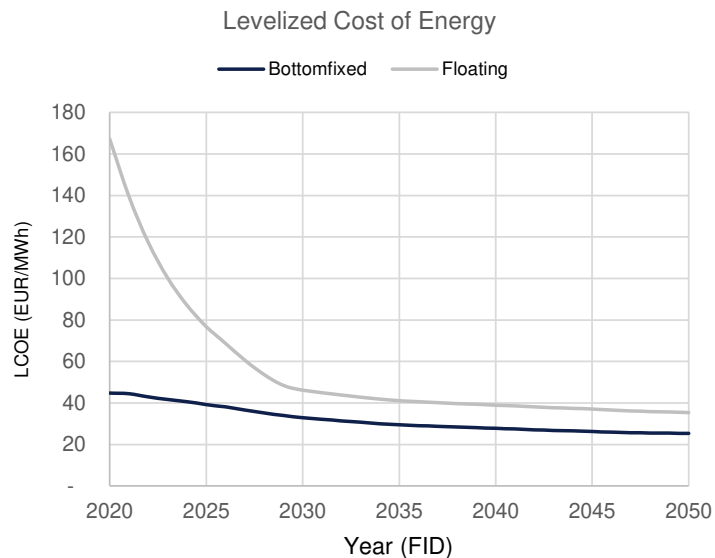
OEDifital • February 22, 2022



The Deepsea Semi floating wind foundation design has been developed for use in floating wind farms and for off-grid applications including temporary electrification of oil and gas installations in harsh environments. ©DNV

Cost reduction journey

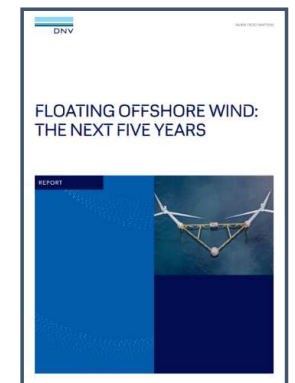
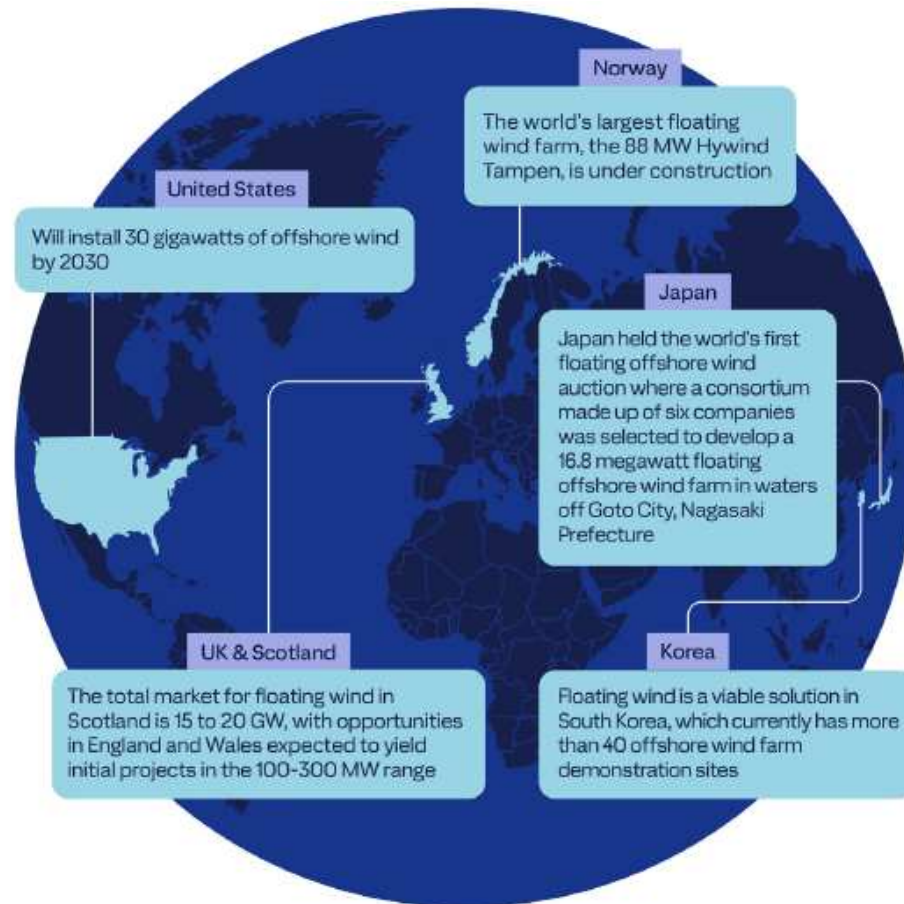
- Floating wind Levelized Cost Of Energy (LCOE) is expected to be **reduced by 80% in the next 30 years** to a global average of 35 €/MWh
- Total investment cost is expected to be 1.7MEUR/MW in 2050, against 5.7MEUR/MW today.
- While the LCOE for floating wind on average is 37% higher than bottom fixed in 2050, deployment will be needed to meet the global demand in offshore wind and bottom fixed cost will be very low at about 26€/MWh.



KEY DRIVERS

- Larger windfarms
- Cooperation and sharing
- Financial incentives
- Auctions
- Larger wind turbines
- Reduced risk
- Standardisation
- Technology development
- Industrialisation
- Construction and operational experience
- Higher capacity factors
- Longer lifetime

Which regions are moving fastest in the floating wind race?



R&D and Joint Industry Projects

Gain value from our worldwide recognized knowledge, being on top of industry developments



Key services

Research & Development (R&D)

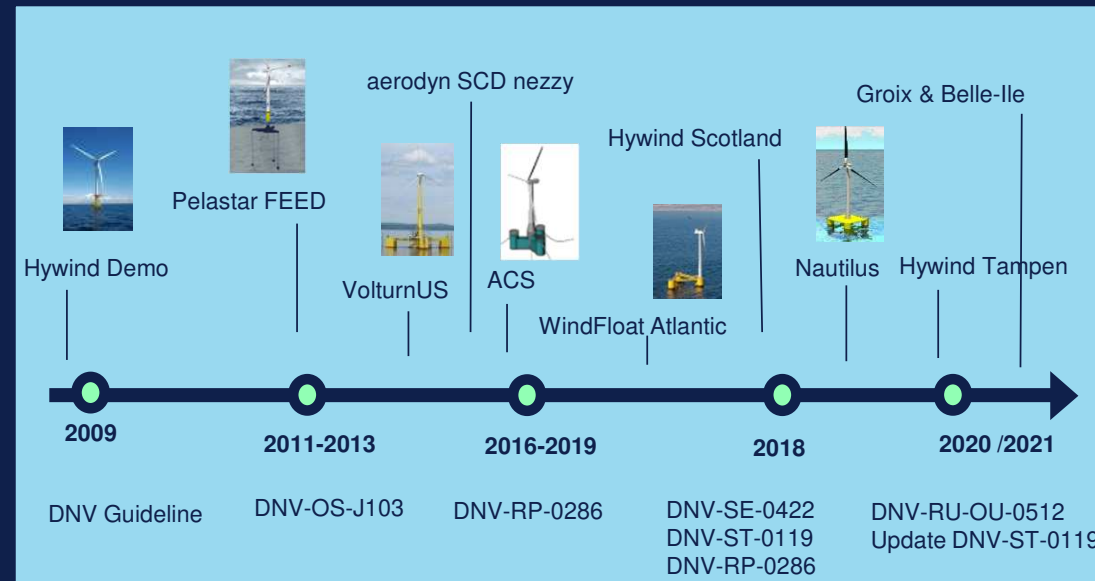
Participation in national and international consortia, working with academia and industry partners

Joint Industry Projects (JIP)

Joint Development projects (JDP)

How we help

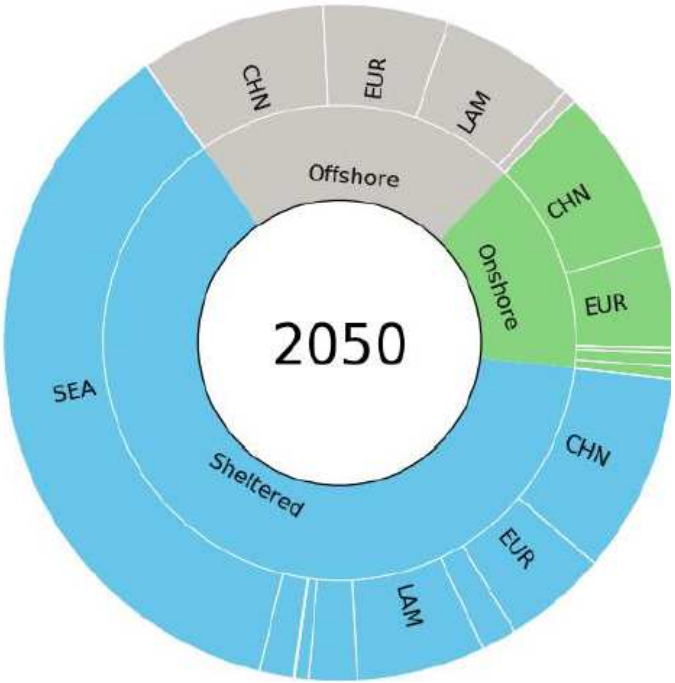
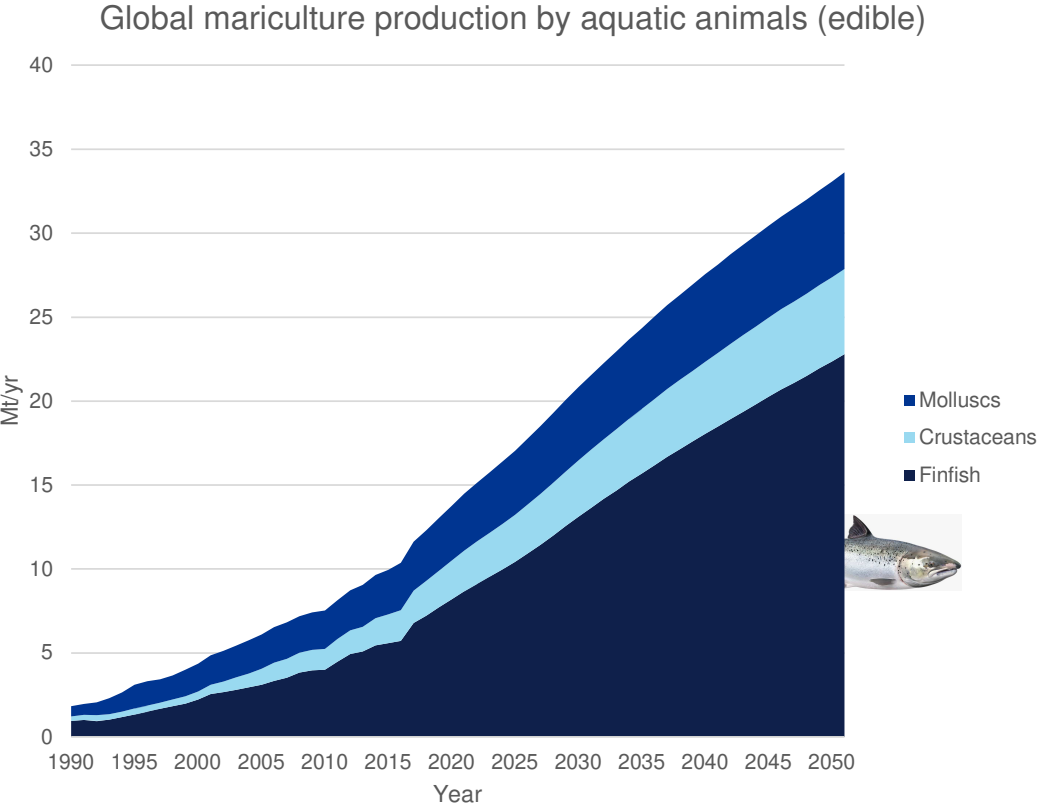
DNV focuses on being at the forefront of technology development and uses 5% of the annual revenue for R&D. This allows us to take a leading position in developing industry standards for floating wind projects.



OFFSHORE FISH FARMING/AQUACULTURE



Future market - Offshore fish farming



Offshore fish farming installations

Trends & characteristics

- Established offshore/maritime designers leading the way
- Industrial trend toward technically advanced installations - away from traditional open net pens
- Exposed aquaculture a growing industry – new companies enters
- Moving towards closed fish pens



Offshore fish farming installations

DNV Newbuilding

FjordMAX

✘ OI - Offshore fish farming installation POSMOOR NYTEK



SpiderCage Hs8

✘ OI - Offshore fish farming installation Posmoor Battery(Safety), Crane, ECO, Aquaculture, NYTEK



Nordlaks Hydra

✘ OI - Offshore fish farming installation Posmoor NYTEK

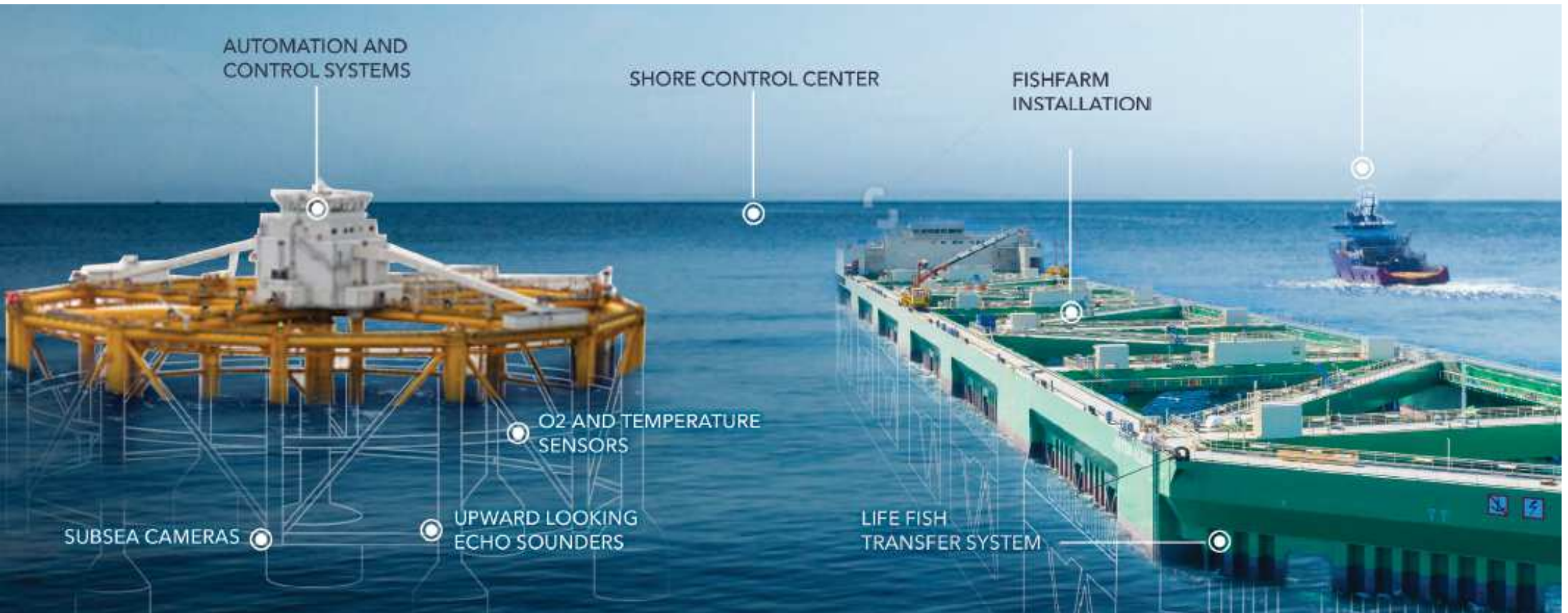


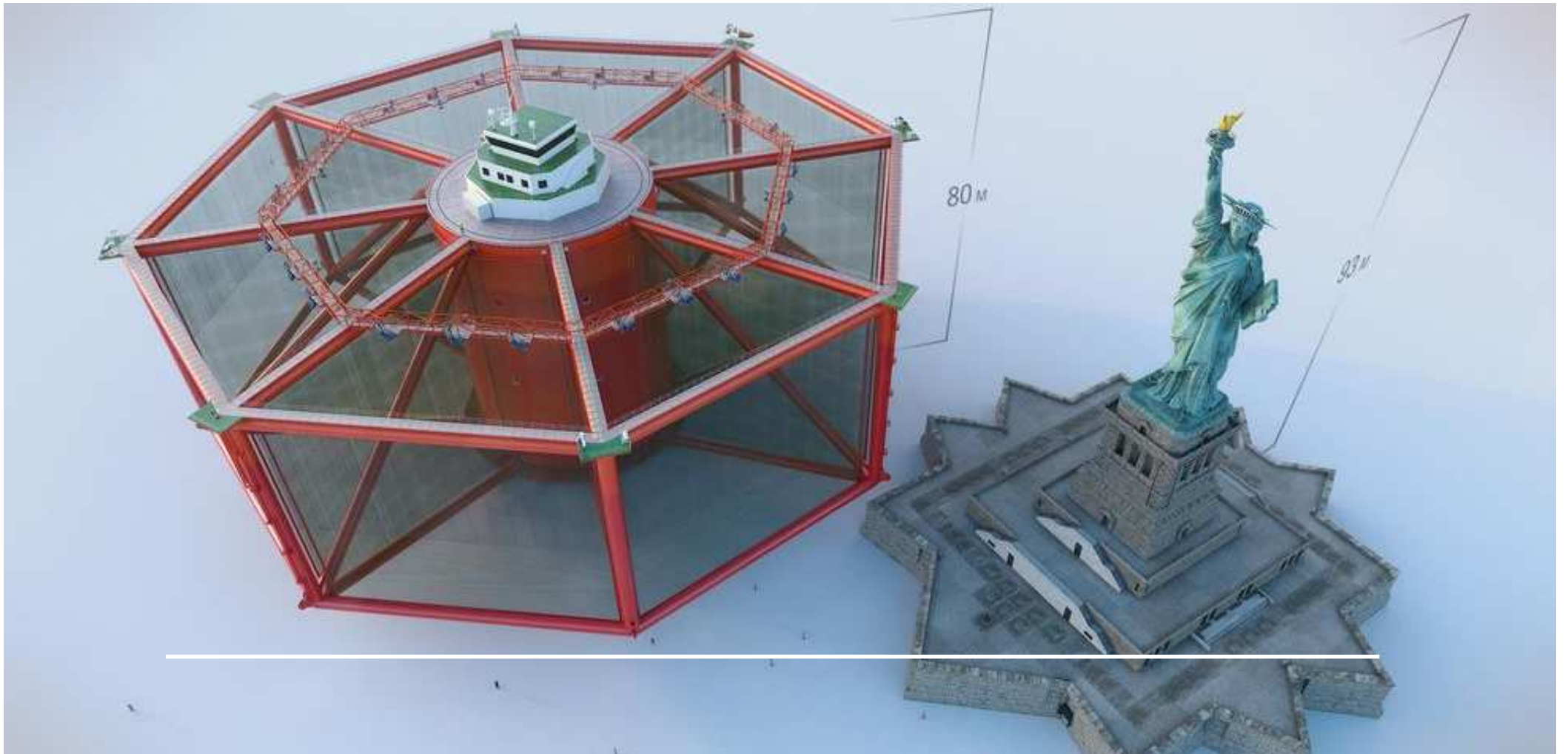
Vard Aqua Semi

✘ OI - Offshore fish farming installation Posmoor NYTEK



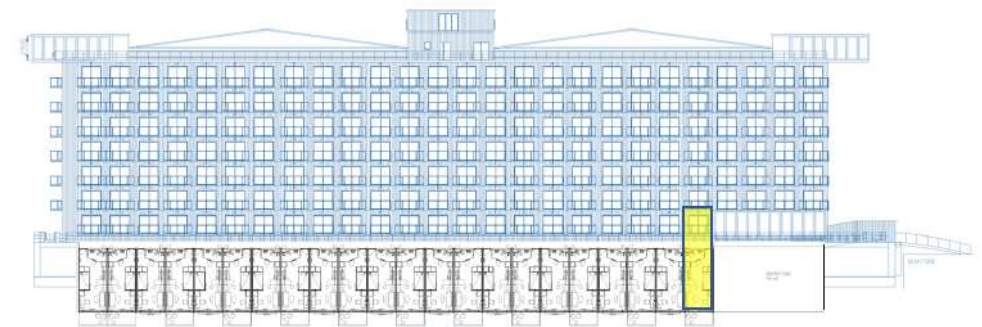
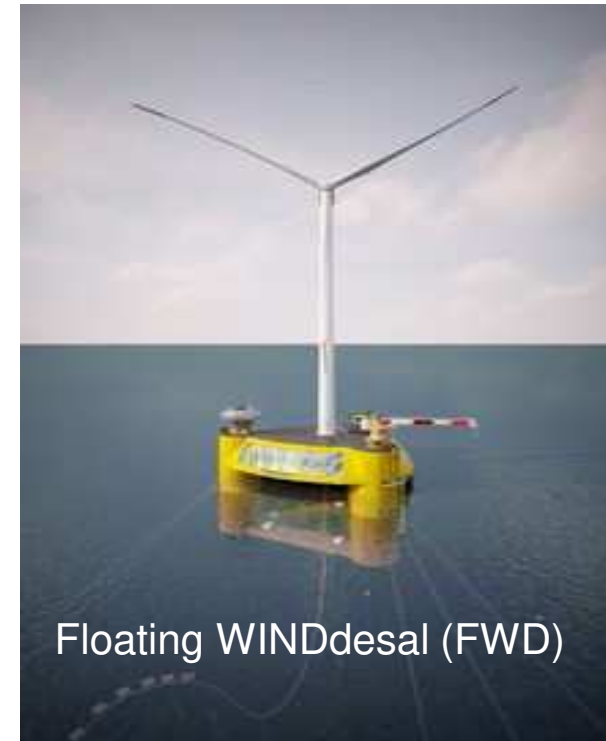
Offshore fish farming installations





Ocean Space Infrastructure - big variety

- Floating Wind powered desalination plant intended for KSA: Floating WINDdesal (FWD)
- Student accommodation
- FOW to H2 (www.switch2offshore.com)



Deep Blue – Student Accommodation

WHEN TRUST MATTERS

Thank You!

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